Remarks

Claims 1-24 were pending in the subject application. By this Amendment, the applicants have amended claims 1-4, 6-10, 12-16, and 18-24. No new subject matter has been added by these amendments. Support for the amendments to the claims can be found throughout the subject application including, for example, at page 8, lines 24-29 and page 21. Accordingly, claims 1-24 are supported by the specification and are now before the Examiner for consideration.

The amendments set forth herein should not be interpreted to indicate that the applicants have agreed with, or acquiesced to, the rejections set forth in the outstanding Office Action. The amendments to the claims have been made in an effort to lend greater clarity to the claimed subject matter and to expedite prosecution. Favorable consideration of the claims now presented, in view of the remarks and amendment set forth herein, is earnestly solicited.

Claims 19-24 have been rejected under 35 U.S.C. §102(e) as being anticipated by Yazdani *et al.* (U.S. Patent No. 6,859,455). The applicants respectfully traverse the grounds for this rejection because the Yazdani reference does not teach or suggest the applicants' advantageous computer program products.

The data structures of the current patent application employ <u>binary search trees</u> (such as red-black search trees) in a very unique manner for <u>dynamic</u> routing processes. Specifically, a binary search tree of <u>points</u> at the top level is applied, wherein each node of the top-level binary search tree contains either another search tree (such as a lower level binary range search tree), an array linear list (ALL), or W-bit vector. The lower level search tree, ALL, or W-bit vector contain a subset of ranges/prefixes in the router table. To obtain the $O(\log^2 n)$ search and $O(\log n)$ insert/delete complexities as claimed, the top level balanced binary search tree can retain a limited number of empty nodes in the structure. As disclosed in the application, by accounting any empty nodes, at most $2n$ nodes are needed in the top-level binary search tree to enable the claimed complexities (*i.e.*, $O(\log^2 n)$ rule/prefix matching and $O(\log n)$ insertion/deletion). Without the capacity to include empty nodes in the top-level binary search tree (PTST), it is not possible to get the claimed complexities.

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Contrary to the assertion by the Office Action that Yazdani teaches each element of the claimed invention, it does not. Yazdani fails to teach dynamic update of prefixes based on top level binary search trees (such as red-black trees as recited in claims 20, 22, and 24) with nodes associated with point values, where each node has either (1) a low level range search tree to a nonintersecting highest priority rule table comprising at least one nonintersecting range and corresponding priority (as recited in claim 19); (2) an array linear list (ALL) to a highest priority prefix table comprising at least one pair, wherein the pair comprises a prefix and corresponding priority (as recited in claim 21); or (3) a W-bit vector (bit(z)) to a longest-matching prefix-table comprising at least one prefix (as recited in claim 23). In stark contrast to the claimed dynamic processes based on balanced binary search trees having at each node either another binary search tree, ALL or W-bit vector, where each node is associated with a point value, Yazdani discloses static routing processes based on prefix data structures that mimic binary search trees, where each "node" of the Yazdani prefix data structures stores a single prefix. As any skilled artisan would readily grasp, search trees, ALLs, and W-bit vectors (which are stored in nodes of the PTST of the subject application) are not the same as prefixes.

Specifically, Yazdani teaches 3 data structures—a 'binary' prefix tree, a static m-way prefix tree, and a dynamic m-way prefix tree—for static packet routing based on longest matching prefixes. The applicants respectfully submit that the Yazdani 'binary' prefix tree is not a binary search tree that includes either another search tree, ALL, or bit(z) at each node; rather, it is essentially a static, sorted prefix table on which a search can be conducted that mimics binary searching (see col. 5 line 64 through col. 6, line 50; and col. 16, line7 through col. 18, line 42). The Yazdani m-way structures are not binary search trees (see col. 19, lines 30-51); rather, they are based on standard B trees. As understood by the skilled artisan, B trees are vastly different from binary search trees. Thus, none of the Yazdani m-way structures would be considered binary search structures, let alone trees that include at each node either another search tree, ALL, or W-bit vector. Applicants further submit that the Yazdani 'binary' prefix tree is not consistently balanced and as such, every time a prefix is inserted, the Yazdani prefix tree needs to be reconstructed (see col. 18, lines 43-53 and col. 19, lines 1-30), making the insert process highly inefficient. As a final note, the applicants respectfully submit

that Yazdani fails to describe delete processes and does not teach dynamic routing for highest priority matching where rules are based on non-intersecting ranges with priority.

It is a basic premise of patent law that, in order to anticipate, a single prior art reference must disclose within its four corners, each and every element of the claimed invention. In *Lindmann v. American Hoist and Derrick Co.*, 221 USPQ 481 (Fed. Cir. 1984), the court stated:

> Anticipation requires the presence in a single prior art reference, disclosure of each and every element of the claimed invention, arranged as in the claim. *Connell v. Sears Roebuck and Co.*, 722 F.2d 1542, 220 USPQ 193 (Fed. Cir. 1983); *SSIH Equip. S.A. v. USITC*, 718 F.2d 365, 216 USPQ 678 (Fed. Cir. 1983). In deciding the issue of anticipation, the [examiner] must identify the elements of the claims, determine their meaning in light of the specification and prosecution history, and identify corresponding elements disclosed in the allegedly anticipating reference. *SSIH, supra*; *Kalman [v. Kimberly-Clarke*, 713 F.2d 760, 218 USPQ 781 (Fed. Cir. 1983)] (emphasis added). 221 USPQ at 485.

In *Dewey & Almy Chem. Co. v. Mimex Co.*, Judge Learned Hand wrote:

> No doctrine of the patent law is better established than that a prior patent . . . to be an anticipation must bear within its four corners adequate directions for the practice [of the subsequent invention] . . . if the earlier disclosure offers no more than a starting point . . . if it does not inform the art without more how to practice the new invention, it has not correspondingly enriched the store of common knowledge, and it is not an anticipation. 124 F.2d 986, 990; 52 USPQ 138 (2nd Cir. 1942).

As noted above, claims 19-24 as currently presented describe dynamic routing processes based on balanced top-level binary search trees having at each node either a lower range binary search tree, an ALL, or a *W*-bit vector. Yazdani fails to disclose any of these elements. Thus, under the applicable statutory and case law, the Yazdani reference does not anticipate the application. Accordingly, reconsideration and withdrawal of this rejection is respectfully requested.

The applicants respectfully traverse the 35 U.S.C. §103(a) rejection of claims 1-18 set forth at pages 7-16 of the office action. This rejection is based on Yazdani *et al.* (U.S. Patent No. 6,859,455) as the primary reference with Turner *et al.* (U.S. Patent No. 6,018,524) as the secondary reference. The deficiencies in Yazdani's data structures have been noted above and are respectfully reasserted herein. As such, the applicants respectfully note that the teachings of the Yazdani reference do not serve to provide proper basis for the obviousness rejection of the claims as currently presented.

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As noted above, the Yazdani m-way structures are based on B trees and are entirely different from binary search trees. As such, searching/inserting/deleting processes for B trees are incompatible with those used with binary search trees. For example, the insertion algorithm for Yazdani's m-way structures (see col. 22) would not be effective with the PTST of the invention. In any event, due to their structure, Yazdani's m-way trees cannot support efficient insert/delete processes.

Further, the Yazdani 'binary' prefix tree does not equate to the top-level binary search tree as currently claimed since it embodies a binary search over a fabricated/sorted list of prefixes (see col. 17), where a single prefix is contained in each node. The Yazdani prefix tree uses prefixes as 'keys'; in contrast, the subject application uses points (such as integers) as keys. As such, during a search, Yazdani *et al.*'s method compares an incoming address with a prefix stored in the current node, whereas the applicants' search simply compares an incoming address with a point, allowing for more efficient search (match)/insert/delete functions.

Because of its underlying (prefix tree) data structure, the applicants submit that the Yazdani routing method is not effective for dynamic tables that must support insert/delete. In fact, applicants respectfully submit that it is theoretically impossible to insert or delete into/from the Yazdani 'binary' prefix tree structure in less than linear ($O(n)$) time. This is because, as described above, a single insert/delete can change the entire sequence of medians used to construct the tree in the first place (see col. 16, lines 37-56). Of further note, only two insert procedures are described (col. 18, lines 43-67 and col. 19, lines 1-29) that relate to the 'binary' prefix tree. Neither procedure attempts to maintain a balanced search tree, which is to be expected since the basis for the Yazdani prefix tree would not accommodate efficient balancing. In fact, Yazdani does not discuss maintaining balance in the prefix tree; rather, it only discusses the need to keep the property of a binary tree, where the keys in left subtree are smaller than the key in the current node and the keys in the right subtree are larger than the key in the current node. As a result, following a series of inserts, the Yazdani prefix tree becomes highly unbalanced and searches no longer are performed in $O(\log n)$. Rather, the prefix tree height may become $O(n)$ and all following search (match) operations would run in $O(n)$ time.

Turner fails to address the deficiencies in Yazdani noted above. In fact, Turner's routing methods are totally different from Yazdani's methods. Turner's routing methods are based on a trie (which as understood by the skilled artisan is not a balanced tree) composed of static tables that require the use rope searches (binary search on prefix lengths) with the help of markers (col. 18, lines 15-26) that are stored in hash tables. In contrast, the dynamic routing methods recited in the claims are based on a point search within a binary search tree (PTST) and not on a rope searches on prefix lengths. Turner's routing methods have O(log *W*) time complexity for lookup and O(n log^2 *W*) time complexity for update (see col. 21, line 24), where *W* is the length of the longest prefix. The worst-case search complexity is O(logW * log n) (provided sets of hash synonyms are maintained as balanced search trees) and so is inferior, in the worst-case, to that of Yazdani. Because of the need to keep markers in each of the hash tables, Turner's update (insert/delete) operations are entirely different from those recited in the claims (see, for example, col. 18, lines 25-34). Further, the applicants respectfully submit that it is theoretically impossible to insert/delete in O(log n) or O(log *W*) time, complexities claimed in the subject application, using the Turner data structure/routing method.

Finally, the applicants submit that Turner's routing methods have no rebalancing step at all. Because the Turner tries are not balanced, the insert/delete procedures are not applicable to the PTST as currently claimed. In fact, because of the need to store markers in each hash table, it is theoretically impossible to insert/delete in less than linear time when the data structure of Turner used.

A finding of obviousness is proper only when the prior art contains a suggestion or teaching of the claimed invention. As discussed above in great detail, both the Yazdani and Turner references fail to teach or suggest routing methods that utilize a top-level binary search tree having at each node either lower range search trees (see claim 1), ALL (see claim 7, or *W*-bit vectors (see claim 13), where each node is associated with a point value (see claims 1, 7, and 13). Further, neither reference teaches or suggests dynamic routing methods that: are directed to highest priority range/prefix (see claims 1 and 7); range search trees to a nonintersecting highest priority rule table (see claim 1); maintain balanced PTST (see claims 1, 5, 7, 11, 13, and 17); delete rules (see claims 6, 12, and 18);

and have insert/delete complexities as claimed (see, $O(\log n)$ time in claims 1 and 13 and $O(W)$ time in claim 7). Due to vast differences in data structures, the Yazdani routing method and Turner routing method are totally different form each other. As such, there is no reason to, let alone possibility of, taking an insertion algorithm from Yazdani and similar algorithm from Turner and "combining" the two to provide efficient insertion and deletion, especially since neither reference describes the claimed deletion rules. As the skilled artisan would readily understand, attempts to modify the Yazdani prefix table and insertion algorithms to include the Turner trie update algorithms would render the Yazdani routing methods inoperable as intended; thus, the skilled artisan would not have found reason to make the combination as suggested in the Office Action. As such, a *prima facie* case of obviousness cannot properly be made.

Further, the applicants submit that it is only their own disclosure that teaches PTST having at each node either a binary search tree, an ALL, or a *W*-bit vector, and the applicants' disclosure cannot be used to reconstruct the prior art for a rejection under 35 U.S.C. §103. This was specifically recognized by the CCPA in *In re Sponnoble*, 160 USPQ 237, 243 (1969):

> The Court must be ever alert not to read obviousness into an invention on the basis of the applicant's own statements; that is we must review the prior art without reading into that art appellant's teachings. *In re Murray*, 112 USPQ 364 (1959); *In re Sprock*, 133 USPQ 360 (1962). The issue, then, is whether the teachings of the prior art would, in and of themselves and without the benefits of appellant's disclosure, make the invention as a whole, obvious. *In re Leonor*, 158 USPQ 20 (1968). (Emphasis in original)

The mere fact that the purported prior art could have been modified or applied in a manner to yield the applicants' invention would not have made the modification or application obvious unless the prior art suggested the desirability of the modification. *In re Gordon*, 221 USPQ 1125, 1127 (Fed. Cir. 1984). Moreover, as expressed by the CAFC, to support a §103 rejection, "[b]oth the suggestion and the expectation of success must be founded in the prior art . . . ." *In re Dow Chemical Co.*, 5 USPQ 2d 1529, 1531 (Fed. Cir. 1988). In the Yazdani and Turner references, one finds neither. The applicants respectfully submit that any suggestion to modify the Yazdani prefix tree to include nodes having either a binary search tree, an ALL, or *W*-bit vector could only be

arrived at through hindsight reconstruction, which is improper. Accordingly, reconsideration and withdrawal of the rejection under 35 U.S.C. §103(a) is respectfully requested.

In view of the foregoing remarks and the amendments above, the applicants believe that the currently pending claims are in condition for allowance, and such action is respectfully requested.

The Commissioner is hereby authorized to charge any fees under 37 CFR §§1.16 or 1.17 as required by this paper to Deposit Account No. 19-0065.

The applicants also invite the Examiner to call the undersigned if clarification is needed on any of this response, or if the Examiner believes a telephone interview would expedite the prosecution of the subject application to completion.

Respectfully submitted,

Margaret Efron
Patent Attorney
Registration No. 47,545
Phone: 352-375-8100
Fax No.: 352-372-5800
Address: P.O. Box 142950
Gainesville, FL 32614-2950

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